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CASE REPORT
Reconstructive

Two-stage Reconstruction of the Scalp with Facial AV Loop

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Summary: We present the case of a 65-year-old woman with extensive osteoradionecrosis of the scalp and calvaria after external beam radiation therapy for follicular lymphoma. Due to the compromise of her adjacent vasculature including the superficial temporal vessels, she underwent two-stage reconstruction with the creation of an AVL (arteriovenous loop) graft utilizing her great saphenous vein. This was anastomosed to her right facial artery and vein, which was then matured. She underwent resection of the necrotic portions of calvaria and soft tissue of approximately 180 cm^2, and a vascularized free latissimus dorsi muscle flap was harvested and anastomosed to her new conduit. This free muscle flap was then covered with a split-thickness skin graft harvested from her thigh. She achieved satisfactory functional and cosmetic results with minimal morbidity and without complication despite her age, multiple co-morbidities, and extensive and complex disease process. *(Plast Reconstr Surg Glob Open 2020;8:e2941; doi: 10.1097/GOX.0000000000002941; Published online 23 June 2020.)*

A 65-year-old woman was evaluated for reconstruction of a complex scalp and calvarial defect after external-beam radiation therapy. She was diagnosed with diffuse large B-cell lymphoma of the scalp and subsequently underwent extensive chemoradiation therapy. Less than 6 months after the completion of her radiation treatment, she developed exposure of her calvaria. Her comorbidities included diabetes mellitus type II, chronic obstructive pulmonary disease (COPD) hypertension, chronic tobacco abuse, and hyperlipidemia. She also had extensive arterial disease with a history including abdominal aortic aneurysm (AAA) repair, bilateral superficial femoral artery stents, and carotid artery stenosis. Osteoradionecrosis was demonstrated on imaging, with small caliber temporal vessels and evidence of postradiation changes with poor flow. The left superficial temporal artery was weakly palpable proximally but nonpalpable on the right. Several options for reconstruction were discussed, and free tissue transfer for coverage was selected.

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With inadequate adjacent recipient vessels, we felt that the use of vein graft was required. Although the left superficial temporal artery was weakly palpable proximally, the imaging demonstrated small vessels with poor flow. We intended to avoid the irradiated field and vasculature as much as possible, especially when combined with the risk of her known peripheral vascular disease. Her osteoradionecrosis was in a greater concentration on the right side of her scalp, which allowed us to plan to explore the right superficial temporal vessels, knowing that it would be exposed. We avoided creating a second, left-sided incision to explore the superficial temporal vessels after consideration of previously mentioned risk factors with examination and imaging findings. The latissimus dorsi muscle was chosen for its ability to cover a large surface area and to allow for adequate contouring along the scalp. Vein mapping demonstrated a noncompressible right greater saphenous vein (GSV), and the distal left GSV was chosen for harvest because of its caliber and length.

With her extensive comorbidities, combined with the irradiated field, we were not confident on the tissue and vessel quality and felt that a more conservative approach was warranted in 2 stages. This meant limiting the number of anastomoses performed at one time by creating an arteriovenous loop (AVL) instead of single-stage vein grafting and allowing her to undergo some stages of healing before flap coverage. We also wanted to allow the AVL to mature and dilate to allow for a better size matching for the final anastomosis.

The patient presented for the first stage of her reconstruction and underwent harvesting of the left GSV and the creation of an AVL between the right facial artery and

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Fig. 1. Osteonecrosis of the scalp and calvaria with planned areas of resection, before creation of defect.

the vein. The right superficial artery was explored and was found to be nonpulsatile, to be of small caliber, and to have poor flow, consistent with the preoperative imaging. Undermining was performed in the preauricular region down through the right cheek to eventually connect to an incision that would be made just below the mandibular border along the right neck to expose the facial artery and vein that were found to be adequate recipient vessels. The distance measured from the facial vessels to the desired location of anastomosis was about 13 cm, and so 26 cm of GSV graft from the left below knee was harvested. Both sets of vessels were again prepared and anastomosed under the microscope and was found to have immediate pulsatile flow. The GSV was tunneled subcutaneously in the right preauricular region with drain placement. After monitoring overnight, the patient was discharged home the next day. The patient returned to clinic 1 week later and was evaluated and found to have adequate Doppler signals and palpable pulsation on examination. She was healing well and was ready to proceed with the second stage the following day.

Fig. 2. Intraoperative photograph of matured great saphenous vein AVL that is anastomosed to right facial artery and vein.

Fig. 3. Intraoperative photograph of free latissimus muscle flap anastomosed to newly created vascular conduit with split-thickness skin graft coverage.

During the second stage of her reconstruction, the area of necrosis was marked to healthy tissue (Fig. 1). Our neurosurgical colleagues then excised a 12 × 15 cm^2 area with a partial craniectomy to expose healthy, bleeding bone. The temporal incision was connected to the newly excised area, exposing the matured graft (Fig. 2). The right latissimus dorsi was dissected out in a standard free muscle flap fashion. At least a 11–12 cm width of latissimus muscle and at least a 15–16 cm of muscle length along the direction of the thoracodorsal vessels were required for the coverage of the scalp. In the submuscular plane up into the right axilla, the thoracodorsal vessels were identified. The serratus branch and the circumflex scapular branch were then clipped and ligated to allow for more length of the pedicle. The flap was then brought up to the scalp region, where it was temporarily secured with suture. The thoracodorsal vessels were noted to be slightly smaller than the AVL, which had dilated since creation. Hand-sewn anastomosis was performed for both vessels due to the vessel size discrepancy. Total ischemia time was 33 minutes. The muscle was inset into position with slight undermining of the surrounding scalp and then secured. After ensuring adequate flow and adequate dilatation of the vessels, the preauricular area was closed once again with monofilament suture. Once complete coverage had been achieved, the area of exposed muscle was measured to be 12 × 15 cm. A 0.016-inch split-thickness skin graft was

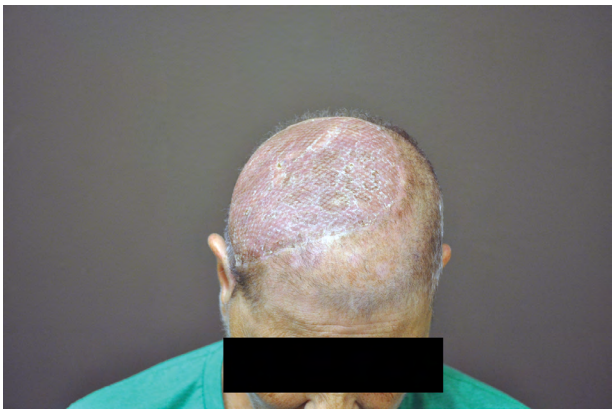

Fig. 4. Photograph of healed complex scalp reconstruction on postoperative day 56 (6 weeks), demonstrating proper contouring and decreased bulk that achieved the desired cosmetic outcome.

then harvested from the right lateral thigh, meshed, and secured (Fig. 3). The flap donor site was closed in standard layered fashion with drains in place.

Postoperatively, the patient was monitored with hourly flap checks in the intensive care unit for 48 hours, transferred to the floor, and eventually discharged on postoperative day 5 after an uncomplicated and expected postoperative course. At the 6-week postoperative day, the patient demonstrated a well-formed and well-healed scalp reconstruction, with the aesthetic and functional outcome she desired (Fig. 4). The explanation of this case is important, as there is a current deficiency in the literature, where very few, if any, reports of 2-stage scalp reconstruction for osteoradionecrosis using an AVL of the facial vessels are described. Due to this patient's extensive comorbidities and disease, irradiated surgical field with compromised adjacent vessels, and a high risk of poor wound healing and flap failure, the preoperative planning for a creative but conservative approach was crucial.

SUMMARY

Complex scalp reconstruction requires extensive preoperative planning based on disease and patient characteristics, especially in geriatric patients.[1] Vascularized free tissue transfer is often required, and many different options have been historically described as suitable grafts based on recipient vessel availability and required pedicle lengths.[2–10] Reconstruction can be performed in 1 stage or in multiple stages if a grafted vascular conduit is needed, such as with the creation of an AVL.[6,8,10,11] Osteoradionecrosis of the scalp and calvaria is an especially complex condition to reconstruct due to the associated vascular compromise and size of the defect after resection.[7,12,13]

We present the case of a 65-year-old woman with extensive osteoradionecrosis of the scalp and calvaria after external-beam radiation therapy for follicular lymphoma. Due to the compromise of her adjacent vasculature including the superficial temporal vessels, she underwent 2-stage reconstruction with the creation of an AVL using her GSV. This was anastomosed to her right facial artery and vein, which was then allowed to mature for 1 week. She then underwent resection of the necrotic portions of the calvaria and soft tissue of approximately 180 cm^2, and a vascularized free latissimus dorsi muscle flap was harvested and anastomosed to her new conduit. This free muscle flap was then covered with a split-thickness skin graft harvested from her thigh. She has achieved satisfactory functional and cosmetic results with minimal morbidity and without complications despite her age, multiple comorbidities, and extensive and complex disease process.

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